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Let velocity at  $D$  for particle from  $A=u$ , for particle from  $B=u_1$ ; then  $u^2=v^2-2gh$ ,  $u_1^2=v_1^2-2gh$ . Now  $CE=h\cot A$ ,  $CF=h\cot B$ .

$$\therefore EF=h\sqrt{[\cot^2 A + \cot^2 B + 2\cot A \cot B \cos(\theta + \varphi)]}=d.$$

$$CG=\frac{1}{2}\sqrt{[2CE^2+2CF^2-EF^2]}=\frac{1}{2}h\sqrt{[\cot^2 A + \cot^2 B - 2\cot A \cot B \cos(\theta + \varphi)]}=l.$$

$\therefore \tan DGC=h/l=\tan C$ , where  $C$ =angle of projection of coalesced particles at  $D$ . Also  $DE=h\operatorname{cosec} A$ ,  $DF=h\operatorname{cosec} B$ .

$$\therefore \cos EDF=\frac{h^2\operatorname{cosec}^2 A+h^2\operatorname{cosec}^2 B-d^2}{2h^2\operatorname{cosec} A\operatorname{cosec} B}=\cos D.$$

$$\therefore \cos D=\sin A \sin B - \cos A \cos B \cos(\theta + \varphi).$$

Let  $w$ =the velocity of the two particles after they coalesce.

$$\text{Then } w=\sqrt{[u^2+u_1^2+2uu_1\cos D]}.$$

$$\therefore \text{Their path is } y=x\tan C-gx^2/2w^2\cos^2 C.$$

$$\text{Ordinate of vertex}=w^2\sin^2 C/2g.$$

$$\text{Latus rectum}=-2w^2\cos^2 C/g.$$

$$\text{Height of latus rectum above } D=\frac{w^2}{2g}(\sin^2 C-\cos^2 C)=\frac{w^2}{2g}(1-2\cos^2 C)=k$$

$$\text{Height of latus rectum above plane of } AB=h+k.$$

131. Proposed by F. P. MATZ, Sc. D., Ph. D., Professor of Mathematics and Astronomy in Defiance College, Defiance, Ohio.

If the distributed weight on the foundations of a building is  $W$  lb./ (feet)<sup>2</sup>, the foundations must be sunk  $D=(W/w)\tan^4(\frac{1}{4}\pi-\frac{1}{2}\psi)$  feet deep in earth of density  $w$  lb./ (feet)<sup>3</sup> and angle of repose  $\psi$ .

No solution of this problem has been received.

132. Proposed by T. U. TAYLOR, C. E., Department of Engineering, University of Texas, Austin, Tex.

1. A parabola, whose axis is vertical, is described on the vertical face of a reservoir wall. If the vertex  $O$  of the parabola is at the bottom of the wall, and the parabola intersects the surface in the points  $A, B$ , find the depth of the center of pressure of the water on the parabolic area  $ABO$ .

2. In the same problem find the center of pressure on the area included between the horizontal line through  $O$ , a vertical through  $B$ , and the curve  $OB$ .

Solution by P. H. PHILBRICK, C. E., Lake Charles, La.

The general formula for the center of pressure, is

$$\bar{x}=\frac{\iint hx \, dx \, dy}{\iint h \, dx \, dy}$$

in which  $h$  is the depth of any point below the surface.

Let  $O$  be the origin, its depth being  $a$ , and the ordinate on the surface  $=b$ .